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RESEARCH

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Predictors of time to unplanned implanon discontinuation in the first year of application at public hospitals in North Shoa, Central Ethiopia: using acceleration failure time model

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Abstract

Introduction Contraceptive discontinuation has become a widespread issue on a global basis. Implants, of which Implanon is the most popular, are only the second most widely used form of modern contraceptive in Ethiopia. However, Implanon was discontinued at a rate as high as 23.4% in Ethiopia within the first year of use. Therefore, the purpose of this study was to identify the incidence rate and predictors of unplanned discontinuation of Implanon in the first year of application at public hospitals in the North Shoa zone, Central Ethiopia.

Methods A retrospective follow-up study was conducted at public hospitals in the North Shoa zone among women who use Implanon. A total of 429 women who wanted their Implanon removed after insertion were selected as study participants during the data collection period. Data were gathered from the family planning initiation and removal registration books as well as by contacting users directly. A log-rank test was used to assess the significance of observed differences between categorical variable strata. The acceleration failure time model with log-normal distribution was used to fit the survival data.

Results The unplanned discontinuation rate Implanon in the first year of insertion was 19.1% with an estimated mean survival time of 10.9 months (95% CI: 10.65, 11.14). Women with an interval period of insertion (AAF = 1.53; 95% CI: 1.06, 2.21), women who chose implanon by themselves (AFF = 1.32; 95% CI: 1.02, 1.71), women who were satisfied with the service (AFF = 1.40; 95% CI: 1.06, 1.83), and women who were given instructions on what to do if they experienced side effects (AFF = 1.85; 95% CI: 1.40, 2.44), had a lower likelihood of discontinuing their implanon in the first year of insertion.

Conclusion The risk of unplanned Implanon discontinuation was found to be high in the study area. Health care providers should pay close attention to clients' needs when delivering family planning services, and the client should ultimately decide whether to use the service. Family planning departments must also engage in early-side effects treatment and reassure clients to lessen discontinuation.

Keywords Predictors, Implanon, Discontinuation, Acceleration failure time, North Shoa, Ethiopia

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Introduction

Implanon is a long acting reversible contraceptive (LARC) implant with a clinical failure rate of 0.1 pregnancies per 100 women per year that is very effective in preventing unintended pregnancy [1]. It comprises a single, thin etonogestrel rod that can be used for up to three years. Implanon works primarily by suppressing ovulation and thickening cervical mucus, which prevents sperm from reaching an egg [1]. Although implants are not the dominant method in any country, they are being discontinued at higher rates [2].

Contraceptive discontinuation has become a widespread issue on a global basis. Significant numbers of women become exposed to the risk of conception after discontinuation and accidental pregnancies that end up in miscarriage, stillbirth, or abortion [3]. Apart from the expected financial strain, an unplanned pregnancy may compel a woman to undergo a risky abortion, potentially causing multiple complications or even the woman's demise. A study in 36 developing nations found that the discontinuation of contraception was responsible for nearly one-third (33%) of unintended recent births and approximately 35% of unintended recent pregnancies [4].

Despite these consequences of discontinuation, a sizable proportion of Implanon users stop using the device after just a year of application. Worldwide, the percentage of Implanon discontinuation in the first year of use varies from 3% in Burkina Faso to 27% in Yemen [5]. A recent study from Pakistan reported an implanon discontinuation rate as high as 49.1% in the first year of use [6]. According to studies conducted in Ethiopia, the discontinuation rate for Implanon within the first year ranged from 18.2% to 23.4% [3, 7, 8].

Implanon use might be discontinued within the first year of application for a variety of factors. Studies conducted around the globe found that factors such as the woman's age, previous use of contraception, partners' education levels, preinsertion counselling, postinsertion follow-up, and autonomous method choice were important determinants [3, 7, 9].

The Ethiopian Ministry of Health has been working on expanding quality family planning services, ensuring the quality of family planning services through improving health care providers' counselling capacity, ensuring equity to access family planning services, and reaching special need populations [10]. Health extension workers in Ethiopia were also trained to provide long-acting family planning services in addition to short-acting family planning services [10]. As a result, implants are currently only Ethiopia's second most popular method of modern contraception. Among implants, Implanon is the most commonly used method in Ethiopia [11, 12]. However, it was reported that 11% of contraceptive implant users discontinued the method within 12 months of use [11].

Few studies have been conducted on the rate and factors associated with Implanon discontinuation in the first year of use in Ethiopia [3, 7, 8]. Almost all of these studies, however, considered deliberate discontinuations such as removals owing to the wish to become pregnant and switches to other forms of contraception as an event of interest [3, 8]. Additionally, some studies possibly introduced recollection bias based on the dates of Implanon insertion and removal [3, 8], while another study's data may not be complete [7] due to the nature of its secondary data source.

There is currently a paucity of data concerning the incidence of early, unplanned discontinuation of Implanon in Ethiopia, and its determinants have not been thoroughly studied. To address the aforementioned gap and make a contribution to the country's achievement of Sustainable Development Goal 3 (SDGs) of family planning, this study undertook a facility-based retrospective study, to determine the incidence and predictors of unplanned termination of Implanon in its first year of use at public hospitals in the North Shoa zone, Central Ethiopia.

Methods

Study design and area

A hospital-based retrospective follow-up study was conducted from January 01 to March 30, 2023 at public hospitals in the North Shoa zone of the Oromia regional state of Ethiopia at a distance of 112 km from the capital city Addis Ababa in the north direction. The zone is administratively divided into 14 districts and two town administrations, and Fitche town is its administrative town. As per the 2007 National census projection, the zone has a total population of 1,786,067, of whom 876,252 were men and 909,815 were [13]. According to the North Shoa zone health information management system's recent report, there were six public hospitals, 63 health centers, and 267 health posts. These health facilities provide multidimensional healthcare services for the catchment's area population.

Study population

All women of reproductive age (15–49 years of age) who were using Implanon in the study areas were the source population. All women who requested the removal of Implanon following insertion during the study period at the study areas were enrolled in the study.

Sample size determination

The minimum sample size for the incidence of unplanned Implanon discontinuation during the first year was determined using data from an earlier study carried out

in Tigray, Ethiopia's Ayder Comprehensive Specialized Hospital [7] using the formula for a single population proportion. Where Zα/2 = 1.96, margin of error = 0.04, p = the study proportion of the rate of discontinuation of Implanon in the first year of use, which was 18.2%, and q = 1-p.

$$\text{Sample size (n)} = \frac{(Z\alpha/2)^2 * p * q \ = 358}{(d)^2}$$

The calculation of the minimum sample size for predictors was considered using the survival analysis formula [14] with the assumption of a 95% CI, statistical power of 80, two population proportions (q0 = proportion of the unexposed group and q1 = proportion of the exposed group), and one-year discontinuation probability and hazard rate from the previous study conducted in Guraghe, Ethiopia [15]. This study took experiencing heavy vaginal bleeding as an exposure variable (had heavy vaginal bleeding as an exposed and never had used as an unexposed); where, q0 = proportion of unexposed Implanon users = 49.3%, q1 = proportion of exposed Implanon users = 50.7%, hazard ratio (HR) = 3.91, Z/2 = 1.96, Z = 0.84, probability of one-year discontinuation of Implanon = 21.9% P (E).

$$\text{Number of events needed(E)} = \frac{(Z\alpha/2 + Z\beta)^2}{(\text{Log HR})^2 * q_0 * q_1} = 89.44$$

$$\text{Samplesize(n)}\frac{E}{P(E)} = 408.4$$

After allowing for a nonresponse rate, the final sample size for this study was 429.

Sampling procedure

The study covered all of the public hospitals that provide family planning services in the study area, including Kuyu General Hospital, Chancho General Hospital, Muke-Turi Primary Hospital, Salale University Comprehensive Specialized Hospital, Sheno Hospital, and Gundomeskel General Hospital. For the same months as the current study's data collection period last year, there were 465 total client flows for Implanon removal: 129, 98, 73, 49, 52, and 64 for Salale University Comprehensive Specialized Hospital, Kuyu General Hospital, Chancho General Hospital, Muke-Turi Primary Hospital, Sheno Hospital, and Gundomeskel General Hospital, respectively. Based on this, the computed sample size was distributed proportionately to each facility. Women who visited these hospitals for implanon removal during the data collection period were then consequently enrolled in the study as participants.

Study variables

Dependent variable

Time to unplanned discontinuation of Implanon during the first year of use is the outcome variable. The event of interest is unplanned discontinuation of Implanon in the first year of use.

Independent variable

The independent variables in this study include sociodemographic factors (age, marital status, residence, user's occupation, partner's occupation, user's educational level, partner's educational level), reproductive health characteristics (number of living children, parity), contraceptive-related factors (previous exposure to modern contraceptives, prior implanon use, side effects, information on contraceptives, autonomy on the method chosen, preinsertion counselling, satisfaction with service given, initiation period, and follow-up after initiation), and health system-related factors such as time it takes to reach a health facility.

Operational definition

Unplanned discontinuation of implanon Unplanned discontinuation of Implanon is the discontinuation of Implanon contraceptives without switching to other methods. It's due to health concerns, partner influence, or misconceptions rather than being done on purposefully, like wanting to get pregnant [7]. Medically necessary removals would not be considered unplanned.

Time to discontinuation Length of follow-up time which is measured in months, i.e., from the insertion of Implanon to its discontinuation within the first year of initiation [7].

Data quality assurance and control

The data extraction checklist was prepared based on the variables found in different literature and available in the family planning initiation and removal registration books. Sociodemographic information and some inquiries about family planning services were gathered through a brief exit interview questionnaire. This face-to-face interview questionnaire was translated from English into Afaan Oromo and then back into English to ensure consistency. A preliminary test was conducted on 5% of the sample size at a nearby healthcare facility called Fitche Health Center I, and the necessary adjustments were made.

Six data collectors and two supervisors were employed to collect the data. Training was given on the

checklist, data collection techniques, study goals, and maintaining participant confidentiality for data collectors. Prior to data entry, the collected data was examined and checked for consistency and completeness.

Data management and analysis

Data was cleaned, coded, and entered into Epi Data version 3.1 and then exported to STATA version 14 for analysis. Descriptive statistics were applied using frequencies and percentages. Estimation of survival probability was performed by using the Kaplan–Meier survival curve. Survival curves were compared by the log-rank test. Uni-variable survival regression was fitted for explanatory variables and those with a *P*-value ≤ 0.25 level of significance were considered for the multivariable analysis. Then, the study applied a stepwise backwards variable selection procedure to obtain the final reduced model. Finally, a multivariable acceleration failure time (AFT) lognormal distribution survival regression model was fitted. The adjusted acceleration factor (AAF) with its 95% confidence interval (CI) was applied, and covariates with a *P*-value < 0.05 in the multivariable analysis were regarded as predictors of unplanned discontinuation of Implanon in the first year of use.

Survival analysis

Survival analysis deals with the analysis of survival data, which is used to measure the time to an event of interest, such as death or failure. The survival times for subjects who left the study early or who finished it without experiencing the event of interest are censored. Each uncensored observation is taken to indicate an event or death [16].

Let T denote the random variable for the survival time of a subject. Assume f(t), $t \geq 0$, denote the probability density function (pdf) of T, and let $F(t) = P(T \leq t)$, $t \geq 0$, be the cumulative distribution function (CDF) of T. The distribution of T is called the survival time distribution. The survival function, S(t), is defined as the probability that a subject survives up to time t [16]:

$$S(t) = P(T > t) = 1 - F(t),\ t \geq 0 \tag{1}$$

The Cox proportional hazards model

The Cox proportional hazard model is one of the most widely used regression model types in survival analysis. The Cox model estimates the hazard ratio, which is always a nonnegative value. The primary attribute of the Cox model is its reliance on the proportional hazards assumption, which states that "coefficients of the hazard function must remain constant across time for a given covariate" [16].

Another important property of the Cox model is that the baseline hazard, h_0 (t), is an unspecified function. This characteristic distinguishes the Cox model as a semi-parametric model [16]. The semi-parametric model offers considerable flexibility and is extensively used because the hazard function is not confined to a certain shape. The hazard function *h* (t) is related to the covariates as a product of a baseline hazard and a function of covariates. The Cox proportional hazard function is given as [17]:

$$h\ (t) = h_0(t)\ \exp\ (\beta x) \tag{2}$$

where h_0: is the baseline hazard function, which depends on t (but not X); exp (βx): a person-specific nonnegative function of covariates x (which does not depend on t, by construction), which scales the baseline hazard function common to all persons.

For some time = t; and for two persons i and j with vectors of characteristics xi and xj, the hazard ratio (HR) is given as [17]:

$$HR = \frac{h_0(t)\ \exp\ (\beta xi)}{h_0(t)\ \exp\ (\beta xj)} \tag{3}$$

Parametric accelerated failure time survival analysis

Despite their advantages over semiparametric models, parametric models are only used in clinical survival research on a limited basis. The primary distinction between Cox model and AFT is that the baseline hazard function is supposed to follow a specific distribution in AFT models. An accelerated failure time model (AFT) is a parametric model in the statistical field of survival analysis that offers an alternative to the often used PH models. Covariate multiplies the hazard by a constant in a PH model, while it accelerates or decelerates a failure status's life cycle (disease, discontinuation, death or recovery) by a constant in an AFT model [17]. The model for accelerated failure time models is given by [18]:

$$\lambda(t,\ x) = \Phi\lambda_0(\Phi t) \tag{4}$$

where ϕ represents the covariate's combined effect, typically ϕ = exp (-(β*ixi*)). The term ϕ, which is constant by assumption, acts as a time scaling factor. Therefore, ϕ > 1: Failure is 'accelerated' (survival time shortened), and ϕ < 1: Failure is 'decelerated' (survival time lengthened). λ_0 is assumed to be parametric. Five regression models are implemented using the AFT parameterization: exponential, gamma, log-logistic, lognormal, and Weibull.

The best fit model selection

Model fitness was checked using the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC).

The lowest AIC and BIC values declare the best fit model [16].

Ethical consideration

The studies involving human participants were reviewed and approved by the Ethical Review Board of Salale University. An official letter was sent to the North Shoa Zone Public Hospitals to grant official permission to undertake research activities in all Hospitals. After informing the study participants of the purpose and procedure, informed verbal consent was obtained from the study participants. The participants were also assured that they had the right to refuse or withdraw if they were not comfortable at any time. The entire data set gathered from the participants was kept confidential by omitting any means of personal identification from the questionnaire.

Result

Descriptive statistics

A total of 429 women were included in the study. Nearly one fifth 61 (19.2%) of women were young (age < 25 years), and among those 12 (19.7%) women discontinued implanon in the first year of use. Most 356 (83%) women were currently married or inunion, and of these 59 (16.6%) had discontinued implanon within the first year of use. Nearly one-thirds (32.6%) of the participants were rural residents, of whom 17.1% discontinued implanon within 12 months of application. Regarding women's education, nearly half 213 (49.7%) of women had secondary and above education, and among these 42 (19.7%) experienced unplanned discontinuation of implanon in the first year of use. Three-fifths 259 (60.4%) of women were housewives of whom 38 (14.7%) discontinued implanon in the first year of use.

Regarding who chose the method, more than three-fifths 262 (61.1%) of women chose implanon by themselves, and of those 40 (15.3%) women discontinued implanon early in the first year of use. Approximately 316 (73.7%) women reported receiving counselling about the benefit of implanon of whom 51 (16.1%) had discontinued implanon. Nearly one-third 48 (31%) of women who had an abortion history discontinued implanon in the first year of use (Table 1).

Comparison of the different covariates in terms of survival time to implanon discontinuation

Kaplan–Meier graphs were generated to observe the difference in the survival time to implanon discontinuation of women for different categorical variables. The log-rank test was carried out to validate the difference between the groups of each categorical variable.

As shown in Fig. 1 there was a statistically significant difference in the survival time between women satisfied with service given during implanon insertion and those who were not satisfied. The risk of implanon discontinuation among women who were not satisfied was significantly higher and different from those who were satisfied (Fig. 1).

The log-rank test result (Table 2) shows that there is statistically significant difference in the survival experience of groups among abortion, marital status, partner education, women occupation, partner occupation, monthly income, number of live children, counselled about implanon side effect, counselled what to do if experienced side effects, counselled about benefit of implanon, contraceptive knowledge, and period of insertion.

Incidence of implanon discontinuation in the first year of use and its causes

A total of 429 women were followed for a minimum of 2 and a maximum of 12 months. At the end of the twelve month period, a total of 82 of the 429 individuals experienced an unplanned discontinuation of implanon while the rest were censored. The unplanned discontinuation rate of Implanon was 8.16% (95% CI: 5.93, 11.18) at six months and 19.1% (95% CI: 15.70, 23.16) at twelve months of use. The estimated mean (restricted) survival time of implanon user women to discontinue in the first year of insertion was 10.9 months (95% CI: 10.65, 11.14). The overall incidence rate of discontinuation was found to be 21.5 per 1000 women-months of observation.

Regarding the reasons cited for the unplanned discontinuation of Implanon during the first year of use were side effects 53 (64.63%), partner separation 9 (10.98%), and husband disapproval 9 (10.98%) (Fig. 2). The most frequently reported side effects that caused Implanon discontinuation, were menstrual disruption (49.1%), followed by unusual headache (26.4%), and arm pain at the site of insertion (15.1%).

Test of proportional-hazards assumption and model comparison

It was essential to verify the proportional hazards (PH) assumption after fitting the final Cox proportional hazard model. The PH assumption simply states that the hazard ratio (HR) does not change over time for specific factors. The Schoenfeld and scaled Schoenfeld residuals are used to test the PH assumption. When the p-value of the rho-statistic for a given covariate is less than 5%, the null hypothesis of the proportionality of the Cox proportional hazard model is rejected.

Since the global test is less than 0.05 (Table 3), we can conclude that the PH assumption is not satisfied and proceed to analyse the survival data using the alternate model, the accelerated failure time (AFT) model.

Table 1 Descriptive summary of characteristics of study participants and bivariable comparison of characteristics by unplanned implanon discontinuation status (429), 2023

Covariates	Categories	Time to unplanned implanon discontinuation		Total N (%)	*p*-value[a]
		Event N (%)	Censored N (%)		
Women education	Secondary and above	42 (19.7)	171 (80.3)	213 (49.7)	0.752
	Below secondary	40 (18.5)	176 (81.5)	216 (50.3)	
Women occupation	Housewife	38 (14.7)	221 (85.3)	259 (60.4)	0.002
	Employed	19 (20.4)	74 (79.6)	93 (21.7)	
	Merchant	25 (32.5)	52 (67.5)	77 (17.9)	
Marital status	Not married/ not inunion	23 (31.5)	50 (68.5)	73 (17)	0.003
	Married/in union	59 (16.6)	297 (83.4)	356 (83)	
Maternal age	< 25 years	12 (19.7)	49 (80.3)	61 (19.2)	0.284
	25–34 years	52 (17.4)	246 (82.6)	298 (64.5)	
	≥ 35 years	18 (25.7)	52 (74.3)	70 (16.3)	
Number of alive children	0 (Don't have)	8 (34.8)	15 (65.2)	23 (5.4)	0.001
	1 or 2	28 (12.4)	198 (87.6)	226 (52.7)	
	> = 3	46 (25.6)	134 (74.4)	180 (41.9)	
Counseled about the benefit	No	31 (27.4)	82 (72.6)	113 (26.3)	0.009
	Yes	51 (16.1)	265 (83.9)	316 (73.7)	
Counseled about the effectiveness	No	18 (17.6)	84 (82.4)	102 (23.8)	0.666
	Yes	64 (19.6)	263 (80.4)	327 (76.2)	
Period of insertion	Post abortion	24 (41.4)	34 (58.6)	58 (13.5)	< 0.001
	Post-partum	41 (18.6)	180 (81.4)	221 (51.5)	
	Interval	17 (11.3)	133 (88.7)	150 (35.0)	
Satisfied with service given	No	36 (38.7)	57 (61.3)	93 (21.7)	< 0.001
	Yes	46 (13.7)	290 (86.3)	336 (78.3)	
Contraceptive use	No	14 (23.7)	45 (76.3)	59 (13.8)	0.332
	Yes	68 (18.4)	302 (81.6)	370 (86.2)	
Told about other contraceptive methods	No	3 (10)	27 (90)	30 (7.0)	0.188
	Yes	79 (19.8)	320 (80.2)	399 (93.0)	
Told about side effects of implanon	No	18 (16.8)	89 (83.2)	107 (24.9)	0.486
	Yes	64 (19.9)	258 (80.1)	322 (75.1)	
Told what to do if experienced side effect	No	32 (30.5)	73 (69.5)	105 (24.5)	0.001
	Yes	50 (15.4)	274 (84.6)	324 (75.5)	

[a] *p*-values were calculated using Chi-square for categorical variables

As a result, the data was fitted using an accelerated failure time model with Weibull, lognormal, and log-logistic distributions as the baseline distribution. The model with the lowest AIC and BIC values is considered to be the best. Based on the AIC and BIC, the log-normal AFT model was found to be the best model to fit the data with a minimum AIC and BIC values of 378.98 and 430.99, respectively (Table 4).

The survival plot in Fig. 3 shows that the survivor function for women who were told what to do if they experienced side effects was above the survivor function for women who were not told what to do if they experienced side effects. This implies that women who were told what to do if they experienced side effects have a lower probability of discontinuing implanon in the first year of use.

Interpretation of the lognormal AFT model results

Table 5 presents the findings of the multivariable lognormal AFT survival analysis of predictors of time to unplanned discontinuation of implanon. The acceleration factor for women who chose implanon by themselves was 1.32 (AAF = 1.32; 95% CI: 1.02, 1.71). This shows that women who chose implanon by themselves have a 32% lower probability of unplanned discontinuation of implanon in the first year of use.

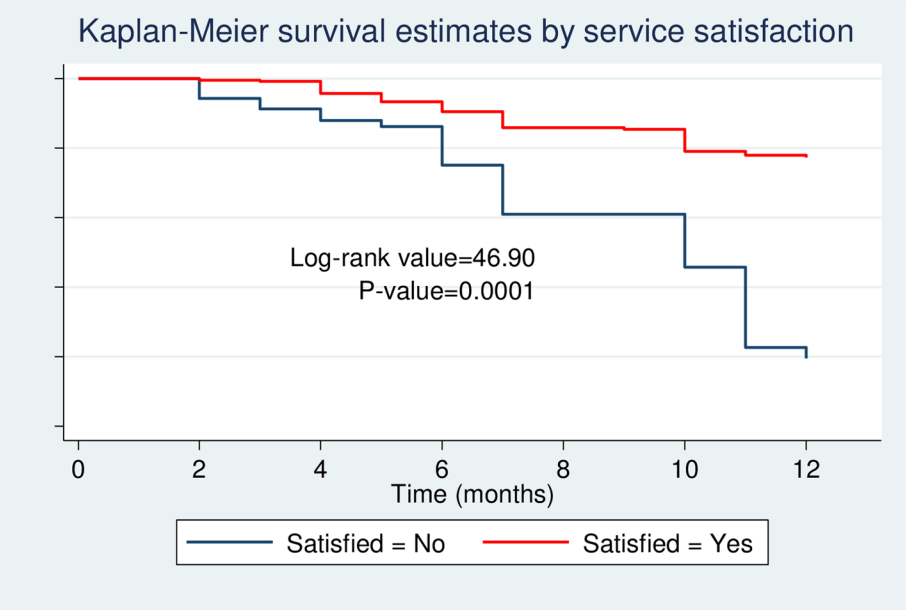

Fig. 1 Kaplan–Meier survival estimate by service satisfaction. In this figure, the survival time of women who were satisfied with service given (red) was significantly different and higher than women who were not satisfied with given service (dark blue). This implies that women who were not satisfied with given service had higher probability to discontinue implanon in the first year of application

Period of insertion was found to be a significant predictor of the survival time to unplanned discontinuation of implanon. The time to unplanned discontinuation of implanon was 1.53 times higher for women with interval insertion as compared to women for whom implanon was inserted post abortion (AFF = 1.53; 95% CI: 1.06, 2.21).

Women who were satisfied with the service provided during insertion had a 40% longer time to unplanned discontinuation of implanon than unsatisfied women (AAF = 140; 95% CI: 1.06, 1.83). This shows that women who were satisfied with the service provided during insertion were less likely to discontinue Implanon during the first year of use.

Women who were told what to do if they experienced side effects related to implanon had a 1.85 times longer time to unplanned discontinuation of implanon (AAF = 1.85; 95% CI: 1.40, 2.44). This indicates that women who were told what to do if they experienced side effects related to implanon have a 1.85 times lower probability of unplanned discontinuation of implanon in the first year of use (Table 5).

Discussion

One of the key indicators of the quality of family planning services is the rate at which contraceptives are discontinued. In spite of their low global utilization, implant contraceptives are discontinued at higher rates [2]. In Ethiopia, implanon is the most widely used implant contraceptive [11, 12]. Therefore, this study explored the time to unplanned discontinuation of implanon and its predictors in the first year of use among women utilizing implanon in the North Shoa Zone, Central Ethiopia, using an accelerated failure time model with a lognormal distribution. This study found that the mean time to unplanned implanon withdrawal in the first year of insertion was approximately 10.9 months (95% CI: 10.65, 11.14).

According to this study, the unplanned discontinuation of Implanon in the study area was found to be 19.1% (95% CI: 15.4, 22.8). This result is comparable to that of studies conducted in South Carolina, USA, and Mekelle, Ethiopia, where the rates of unplanned implanon discontinuation were 16% and 18.2%, respectively [7, 19]. Additionally, a study conducted in Ethiopia's Mettu district found a consistent (19.3%) withdrawal rate during the first year of use [8]. However, this finding is significantly lower compared to a study from Pakistan, where, the implanon discontinuation rate in the first year of use was reported to be 49.1% [6].

This finding is higher than studies conducted in Australia [20], Thailand [21], Egypt [9], and the DRC [22]. The low rate of discontinuations in our study could be related to the fact that we considered only unplanned discontinuations (discontinuations other than owing to the wish to become pregnant and switches to other forms of contraception). Possible variation in service delivery settings could also be the reason for this difference in discontinuation rates.

Table 2 Comparison of survival time of factors of time to unplanned discontinuation of implanon among study participants (429), 2023

Covariates	Categories	Time to unplanned implanon discontinuation		Log-rank test	*P*-value
		Event observed	Event expected		
Satisfied with service given	No	36	14	46.90	0.0001
	Yes	46	68		
Ever faced abortion	No	34	54	22.19	0.0001
	Yes	48	28		
Who chose method	Health professional	28	20	19.16	0.0003
	Husband/partner	12	5		
	Self	40	56		
	Significant others	2	1		
Women occupation	Employed	19	19	13.57	0.0011
	House wife	38	50		
	Merchant	25	13		
Parity	Nullipara	8	4	13.53	0.0012
	Below 3	24	39		
	3 and above	50	39		
Partner education	Secondary & above	40	53	9.80	0.0017
	Below secondary	42	29		
Residency	Rural	24	20	1.04	0.3081
	Urban	58	62		
Women age	< 24 years	12	9	2.02	0.3645
	25–34 years	52	58		
	≥ 35 years	18	15		
Implanon history	No	43	47	0.80	0.3714
	Yes	38	35		
Pregnancy desire	No	43	47	0.81	0.3675
	Yes	39	35		
Counseled about the effectiveness	No	18	17	0.07	0.7968
	Yes	64	65		

In the current study, experiencing side effects was the frequently reported cause of unplanned discontinuation of implanon in the first year of insertion with menstrual disruption being the most common side effect resulting in discontinuation. This finding is supported by previous studies around the world [8, 9, 22, 23]. According to a study from Egypt, respondents who experienced side effects of Implanon use were 3.6 times more likely to discontinue it before one years of use [9]. A study from Mettu district, Ethiopia showed that, women who experienced menstrual disturbance after insertion of implanon were more likely to discontinue implanon early when compared to their counterparts [8]. Another study from DRC showed that, women who experienced heavy / prolonged vaginal bleeding were 1.96 times more likely to discontinue implanon early as compared to their counterparts [22].

Period of insertion was found to be a significant predictor of the survival time to unplanned discontinuation of implanon. Women with interval insertion were less likely to discontinue implanon during the first year of use. A study from Thailand showed that women who were in their postpartum period during the insertion of implanon were 8 times more likely to discontinue implanon by 12 months of use compared to those who did not use any contraception at baseline [23].

Women who chose implanon by themselves were less likely to discontinue Implanon during the first year of use compared to those women for whom health professionals made the choice. This evidence is supported by previous studies [3]. A study from Dale district, Southern Ethiopia, found that women who did not choose the method by themselves were 1,83 times more likely to have discontinuation of Implanon [3]. This could indicate that women's

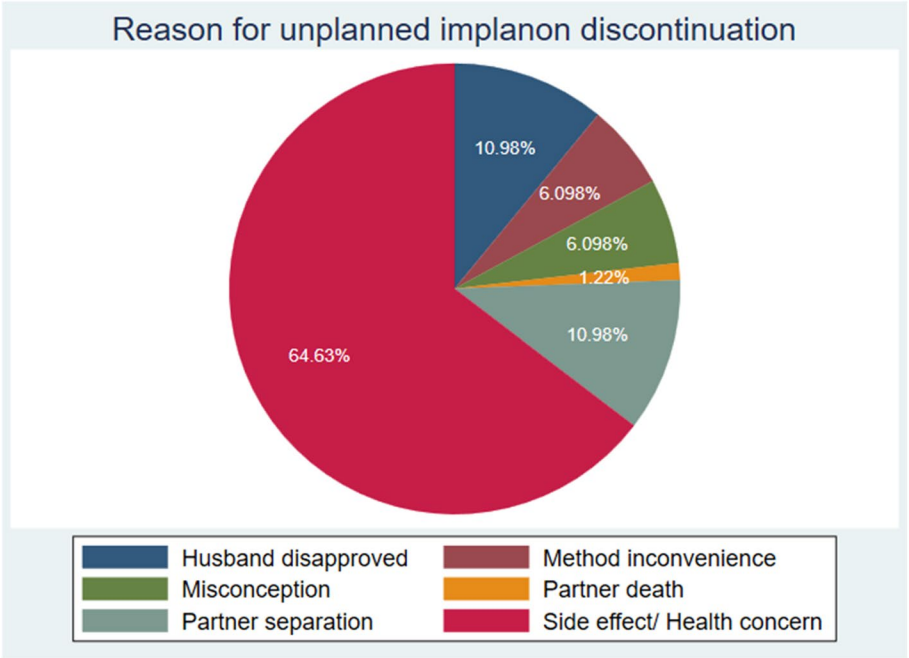

Fig. 2 Reason for unplanned discontinuation of implanon. As shown in this figure, the most frequent reasons for the unplanned discontinuation of Implanon during the first year of use were side effect 53 (64.63%), partner separation 9 (10.98%), and husband or partner disapproval 9 (10.98%)

Table 3 Test of proportional-hazards assumption

Covariates	Categories	Rho	Chi-square	Prob > chi2
Partner education	Secondary and above	1		
	Below secondary	-0.08636	1.05	0.3048
Women occupation	Employed	1		
	Housewife	-0.05590	0.23	0.6334
	Merchant	0.06835	0.46	0.4990
Ever faced abortion	No	1		
	Yes	0.17099	3.23	0.0724
Period of insertion	Post abortion	1		
	Post-partum	0.04979	0.24	0.6232
	Interval	-0.06369	0.39	0.5330
Whose chose method	Health professional	1		
	Husband/partner	0.11495	1.73	0.1879
	Self	0.24307	5.80	0.0160
	Significant others	0.04293	0.16	0.6892
Told what to do if experienced side effects	No	1		
	Yes	0.12112	2.49	0.1143
Satisfied with service given	No	1		
	Yes	-0.10717	2.68	0.1017
Global test			26.51	0.0054

autonomy in making decisions is essential to the demand for and continuation of services related to their health.

The risk of unplanned discontinuation of implanon is lower for women who were satisfied with the service provided compared to unsatisfied women. This evidence is corroborated by other similar studies from different parts of Ethiopia [3, 24–26]. A study from Woliso, Ethiopia found that women who were satisfied with the service

Table 4 Comparison of AFT model with different baseline distributions

Model	Parameters	-Log Likelihood value (Full)	AIC value	BIC value
Exponential	12	-207.56	439.11	487.13
Weibull	13	-178.96	383.92	435.93
Log-normal	13	-176.49	378.98	430.99
Log-logistic	13	-176.85	379.69	431.71

given during the insertion of Implanon were 93% less likely to discontinue Implanon early as compared to those who were not satisfied [24]. Another study from Gamo Gofa, Southern Ethiopia revealed that women who were not satisfied by the service provided during the insertion were 5.2 times more likely to discontinue Implanon than those who were satisfied by the service provided [25].

Women who were told what to do if they experienced side effects related to implanon had a 47% lower probability of unplanned discontinuation of implanon during the first year of use. This finding is in agreement with findings of previous studies [27, 28]. A community-based study from Jimma found that the odds of early discontinuation among women who were not told to return to the health facility if they experienced any side effects were 1.8 times higher than those who were properly advised [27]. Another similar study from Northwest Ethiopia showed that women who received appointment follow-up had lower odds of Implanon discontinuation [28].

This result might be explained by the fact that the women who received instructions were able to seek the right help when they faced side effects and health issues while utilizing the method, which in turn prevented the discontinuation of the implanon. Therefore, to prolong the duration of implanon use by the clients, health care providers in the family planning service unit should emphasize follow-up after insertion.

This study failed to demonstrate an association between a previous history of implanon use and implanon discontinuation. Studies from different countries [9, 22], however, demonstrated an association. A study from Egypt found that clients who had previously used Implanon were less likely to discontinue Implanon use before 12 months of use [9]. Another study from the Democratic Republic of Congo demonstrated a higher likelihood of implanon discontinuation among women who never used injectables or implants in the past compared to those who had a history of injectable or implant use [22].

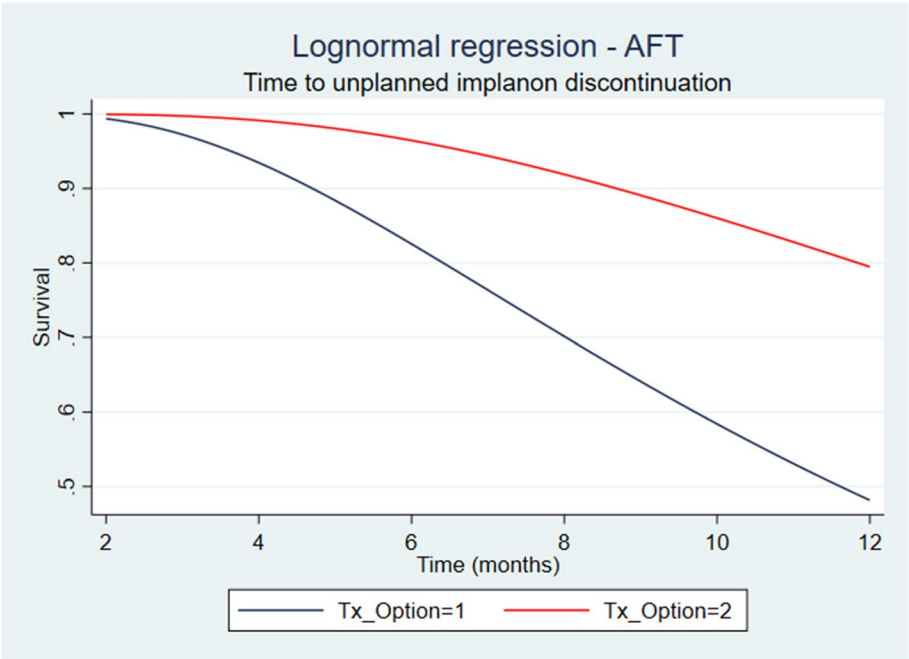

Fig. 3 Lognormal AFT regression of time to implanon discontinuation by whether told what to do if experienced side effects. The survival curve in this figure shows that the survivor function for women who were told what to do if experienced side effect (red or Tx_Option = 2) is above the survivor function for women who were not told what to do if experienced side effect (dark blue or Tx_Option = 1). From this we can understand that women who were told what to do if experienced side effects (red or Tx_Option = 2) have a long waiting time until the failure event (discontinuation) occurs compared to those women who were not told what to do if experienced side effect (dark blue or Tx_Option = 1)

Table 5 Multivariable lognormal AFT survival regression of time to unplanned implanon discontinuation among study participants (429), 2023

Variable	Categories	Coeff	SE	Acce. Factor (ϕ)	95% CI. for ϕ		*p*-value
Partner education	Secondary and above	1					
	Below secondary	0.05	0.14	1.05	0.80	1.37	0.725
Women occupation	Employed	1					
	Housewife	0.25	0.17	1.28	0.92	1.79	0.142
	Merchant	-0.09	0.19	0.91	0.62	1.33	0.630
Ever faced abortion	No	1					
	Yes	-0.12	0.12	0.89	0.70	1.12	0.313
Period of insertion	Post abortion	1					
	Post-partum	0.14	0.18	1.15	0.80	1.64	0.450
	Interval	0.43	0.19	1.53	1.06	2.21	0.022
Who chose method	Health professional	1					
	My husband/partner	0.35	0.26	1.42	0.85	2.37	0.183
	My self	0.28	0.13	1.32	1.02	1.71	0.038
	Significant others	-0.41	0.41	0.66	0.30	1.47	0.315
Told what to do if experienced side effects	No	1					
	Yes	0.61	0.14	1.85	1.40	2.44	0.001
Satisfied with service given	No	1		1			
	Yes	0.33	0.14	1.40	1.06	1.83	0.016
Constant		1.68	0.24	5.37	2.27	13.1	0.001
Constant		-0.35	0.08	-0.35	-0.51	-0.18	0.001

Study limitations and strengths

There is doubt about the study population's representativeness because the charts in the study only included those of women who sought medical attention for implanon removal following certain insertion times during the data collection period. Recall bias may have been introduced when participants were asked about their experiences at the time of implanon insertion.

Apart from this, the study tried to incorporate rich data using both primary and secondary sources of data. The multicentric approach of the study may have enhanced the generalizability of the findings.

Implications for policy, practice and research

This study has program implications since it highlights the importance of improving healthcare practitioners' ability to manage the side effects of contraceptives. Along with learning the proper insertion and removal techniques, healthcare personnel should also receive training on managing the side effects of contraceptives to ensure long-term use of these methods. Furthermore, it is critical that follow-ups be included in family planning services in order to monitor adverse effects early on and ensure that contraceptive techniques are sustained.

The current study suggests that future researchers conduct prospective follow-up studies in order to obtain a comprehensive understanding of the sustainability of the method over time. Prospective studies are essential to ascertain the factors leading to unplanned discontinuation of the method. Furthermore, future researchers are advised to undertake in-depth qualitative studies in order to comprehend the user's insight towards this implant contraceptive (Implanon), and the role of the partner and the community as a whole in the sustained utilization of the method.

Conclusion

The risk of unplanned Implanon discontinuation was found to be high in the study area. Period of insertion, autonomy on method chosen, service satisfaction, and told what to do if experienced side effects of implanon were identified as significant predictors of unplanned Implanon discontinuation. Family planning departments must also engage in early-side effects treatment and reassure clients to lessen discontinuation. Health care providers should pay close attention to clients' needs when delivering family planning services, and the client should ultimately decide whether to use the service.

Abbreviations

AAF Adjusted Acceleration Factor
AFT Accelerated Failure Time
CI Confidence Interval
DHS Demographic and Health Survey
EMDHS Ethiopian Mini Demographic and Health Survey

HEWs	Health Extension Workers
LARC	Long Acting Reversible Contraceptive
PH	Proportional Hazard
SDGs	Sustainable Development Goals

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Authors' contributions
B.T.O conceived the study, participated in its design and coordination, initiated the research, carried out the statistical analysis, interpreted the results, and wrote the final manuscript, critically reviewing it. H.Z.A., D.G.T., and H.I.G. participated in the study's design, guided the statistical analysis, and critically reviewed the manuscript. D.H., and B.M.C. were involved in principal supervision, participated in the study's design and coordination, edited the manuscript, and critically reviewed the manuscript. B.T.O. has main responsibility for the final content, and makes the decision to publish. The authors have read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The studies involving human participants were reviewed and approved by the Ethical Review Board of Salale University. After informing the study participants of the purpose and procedure, informed verbal consent was obtained from the study participants. The participant's right to discontinue or leave the study was also secured. This study was performed in line with the principles of the Declaration of Helsinki. The entire information collected from the study participants was handled confidentially by omitting their identifiers.

Competing interests
The authors declare no competing interests.

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